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XXI. *Observations on the Changes which Blood undergoes, when extravasated into the urinary Bladder, and retained for some Time in that Viscus, mixed with the Urine. By Everard Home, Esq. F. R. S.*

Read June 16, 1796.

THE greater number of cases in physic and surgery are only important and interesting to those engaged in the study of medicine; they are not connected with general science, and therefore do not properly come under the consideration of this learned Society.

Practitioners, however, in these professions have, upon many occasions, brought to light facts of importance in the animal œconomy, which could only be discovered while the human body was labouring under disease; and those have been distinguished with a place in the Philosophical Transactions.

As every change the blood undergoes must appear an object of importance to those who study the œconomy of animals, I am induced to believe the present observations on the change produced on it by being mixed with the urine, will not be considered as wholly undeserving of notice.

I was led to pay attention to this subject from considering the following case, which came under my care.

A gentleman, seventy-one years of age, in the spring 1795, found that in making water, the urine had the appearance of

blood, and congealed into a solid mass as soon as received into the vessel. This complaint appeared to have arisen from the rupture of a vessel in one of the kidneys, for he had a pain in his loins, but none in the region of the bladder. He seemed to void no water, for the whole quantity which was expelled at any one time, amounting to about 4 ounces, formed itself into a coagulum; next day he voided bloody water, which did not coagulate. This continued for three or four days, and then went entirely off.

In the spring, 1796, he had a return of the same complaint. It came on in the evening of the 3d of April; on the 4th it was very violent; and in the afternoon there was a total suppression. A catheter was passed six or seven times; but the oval holes near the end of the instrument were always filled with coagulated blood, and no urine could be drawn off. On the 5th, a larger catheter was passed, with small round holes, less likely to have the coagulum entangled in them, but no urine came away. In the evening it was introduced again, having its cavity completely lined with a flexible gum catheter, which was withdrawn as soon as the instrument was carried to the fundus of the bladder; and in this way 4 ounces of a bloody fluid were drawn off, which on exposure coagulated.

On the morning of the 6th, a pint of bloody urine was drawn off; this operation was repeated three times in the twenty-four hours, and the same quantity was brought away each time.

On the 7th, the urine drawn off was less tinged with blood; and when it was allowed to stand, the upper part became tolerably clear. There was little change in the circumstances for six days; but on the 13th the urine drawn off was of a darker red colour, and in smaller quantity. On the 16th, the

colour was more of a light brown, and after standing some time, a whitish powder was deposited ; the urine drawn off in the morning upon getting up, was nearly of the natural appearance, but that brought away in the course of the day, had a deeper tinge, and more of the white sediment. It is also to be remarked, that the sediment evidently passed off only with the last part of the urine. On the 19th, the urine was tolerably clear, and the white sediment more completely separated, and in greater quantity. In the course of the night, while lying in bed, the patient voided naturally in many different attempts, 4 ounces of water, but could not make any when up. The urine now continued clear from any tinge, but no more passed without the catheter being introduced, till the 28th, when he again made some water naturally, but could not completely empty the bladder ; on the 29th, the quantity which required being drawn off was less ; and by the 5th of May he made water as usual, at which time the sediment began to diminish, and gradually disappeared.

From the symptoms which have been stated, it appears that part of the blood which passed into the bladder from the kidney had remained there, and formed a coagulum, which coagulum gave a bloody tinge to the urine, and caused an inability to void it without assistance, till the coagulum was dissolved.

With a view to ascertain how far this had been the case, and discover what changes the blood undergoes when placed in such circumstances, I instituted the following experiments. They were performed by Mr. CHARLES GROVER, a very ingenious surgeon, at present house surgeon in St. George's hospital.

Experiment I. Four ounces of blood were drawn from the arm into a phial containing 4 ounces of fresh urine, and the phial was kept in the temperature of the human body; in fifteen minutes the whole mixture formed an uniform firm coagulum, and appeared wholly composed of blood.

This experiment was made to ascertain the probable time the blood would take to coagulate in the bladder.

Experiment II. Six ounces of blood were drawn from the arm into 6 ounces of fresh urine; in fifteen minutes the whole mass became one solid coagulum. In seven hours, 6 drams of clear fluid were separated from it; this was poured off, and the same quantity of fresh urine was added; after standing nine hours it was poured off; some red globules were mixed with it, but sunk to the bottom undissolved. The coagulum had fresh urine added to it three times a day, the former urine being previously poured off, and allowed to stand some hours for examination.

For the first five days the coagulum appeared to undergo little change, except becoming smaller in size, and the urine poured off from it was tolerably clear, but on standing deposited a dark cloudy sediment.

On the sixth day, the urine, when poured off from the coagulum, was of a dark red colour, and deposited a greater quantity of a dark coloured sediment, but on standing became tolerably clear.

On the ninth day, the coagulum was reduced to the size of the original quantity of blood drawn from the arm.

On the 13th day, the size of the coagulum was a good deal reduced; the urine poured off from it was still more tinged with the red globules; but when allowed to stand, the upper

part became clear, and free from the red tinge, and the sediment had the appearance of a whitish powder. From this time the quantity of white sediment increased, and the size of the coagulum diminished. In its decrease from this period the loss was from its external surface, and nearly equally all round ; what remained appearing like the nucleus of the original coagulum. On the twenty-fifth day, it was of the size of a large cherry, and on the twenty-ninth it entirely disappeared. Some red globules were very distinctly seen in the sediment along with the white powder.

To see how far the changes the blood had undergone in this experiment depended on the peculiar properties of the urine, the following experiment was made, with blood and common water.

Experiment III. Six ounces of blood were drawn from the arm into 6 ounces of water. In a quarter of an hour, the whole became one solid coagulum. In twelve hours, 6 ounces of a clear water, of a bright red colour, were separated, nor did it on standing deposite any sediment.

This coagulum had fresh water added to it twice a day, and what was poured off was allowed to stand for examination.

The coagulum on the second day began to break ; on the fifth had a putrid smell ; and in eighteen days was almost entirely dissolved.

The water which was poured off was of a bright red colour from the beginning to the end of the experiment, in consequence of the red globules being dissolved ; it had a very offensive smell, but never deposited any white sediment ; the coagulating lymph dissolving from putrefaction.

As it is evident, from the result of the last experiment, that

the coagulum remaining so long undissolved in the second experiment depended upon its being mixed with the urine, I was desirous of knowing whether it was the urine incorporated with the coagulum, or that which surrounded it, which produced this effect. To determine this point I instituted the following experiment.

Experiment iv. Four ounces of blood were drawn from the arm into a cup, and allowed to coagulate. 4 ounces more were drawn into a separate cup. From each of these equal portions of coagulum, at the end of three hours, 1 ounce of serum was separated, and poured off. To one of them fresh urine was added ; to the other common water. The urine and water were changed night and morning.

The water was tinged of a bright red colour throughout the whole experiment, and deposited no sediment. On the eighth day the coagulum was rather looser in its texture. On the thirteenth day it began to break, and by the twentieth day it was nearly dissolved. The progress corresponding with that of the coagulum in *Experiment iii.*

The urine the second day of the experiment was clear, but the bottom of the bason was covered with red globules, undissolved.

On the fifth day, the urine poured off was tinged of a bright red colour, similar to the water taken from the other coagulum ; and after standing some hours a white sediment was deposited.

On the thirteenth day it was looser in texture, and more dissolved than the coagulum in the water. It continued to tinge the urine of a bright red colour, and what was poured off deposited a white sediment in greater quantity. On the

eighteenth, the coagulum was nearly dissolved ; so that the coagulum immersed in the urine dissolved two days sooner than that in the water.

From this experiment we find, that it was the urine incorporated with the coagulum in *Experiment II.* that prevented the red globules from dissolving, and preserved the coagulum for so long a time, since these effects were not produced by urine while simply surrounding the coagulum.

If we compare *Experiment II.* with the result of the case, they agree so entirely, that it leaves no doubt of the process carried on in the bladder being similar to that which took place out of the body. The patient was unable to make water for twenty-four days, although the passages readily admitted, during the whole of that time, an uncommonly large instrument, which could not have been the case had there been any obstruction in them ; for six days more he voided it with difficulty, but afterwards made water very well.

The coagulum out of the body was reduced in twenty-five days to the size of a cherry, and in four days more it was completely dissolved.

The patient's urine became darker, from the red globules mixing with it, in nine days. In the experiment this took place in five days.

The white sediment was first observed, in both instances, about the twelfth day ; it continued to be deposited till the patient got well, and to the end of the experiment.

That the blood is capable of uniting with a quantity of urine equal to itself, so as to form a firm coagulum ; that the red globules do not dissolve in a coagulum so formed ; that an admixture of urine prevents the blood from becoming putrid ;

and that the coagulating lymph breaks down into parts almost resembling a soft powder, are facts which I believe to be new ; —they may, however, have been before ascertained, although I have not been acquainted with them.

They are certainly not generally known, and one object of the present paper is to communicate them to others.

These facts, considered abstractedly, may not appear of much importance ; but when compared with what takes place in the living body, and found to agree with the process the blood undergoes in the urinary bladder, they become of no small value, since they enable us to account for the symptoms that occur in that disease, and lead to the most simple and effectual mode of relieving them.